Patent claims

1. Method for determining a spatial position (AP, AP1, AP2, AP3) of a hand-held measuring appliance (4a, 4b, 4c, 4d), comprising
   - a quantity of reference points (2a, 2a′, 2b, 2b′) which have been made detectable, the quantity comprising at least two reference points (2a, 2a′, 2b, 2b′), and
   - the hand-held measuring appliance (4a, 4b, 4c, 4d) which is formed for detecting and measuring the reference points (2a, 2a′, 2b, 2b′) by means of laser radiation (L),

   comprising the steps
   - derivation of the positions of the reference points (2a, 2a′, 2b, 2b′), in particular by surveying the reference points (2a, 2a′, 2b, 2b′) from at least one known initial position,
   - automatic detection and derivation of location information relative to at least one first and one second reference point (2a′, 2b′) from the quantity by the measuring appliance (4a, 4b, 4c, 4d),
     - o at least one spatial segment (5, 5′, 5′′) being automatically scanned in a scanning movement (6, 6′, 6′′) by the laser radiation (L) and the first and second reference points (2a′, 2b′) being detected, and
     - o the location information for at least the detected first and second reference points (2a′, 2b′) being derived by

measuring at least

- the distance (A) between measuring appliance (4a, 4b, 4c, 4d) and first reference point (2a', 2b') and
- the distance (B) between measuring appliance (4a, 4b, 4c, 4d) and second reference point and/or the angle (γ) between first and second reference points (2a', 2b'),
- and
  - the angle of inclination (α, β) to the first or to the second reference point (2a', 2b') or
  - at least one distance to a third reference point (2a', 2b'),

- derivation of an actual position (AP, AP1, AP2, AP3) of the measuring appliance (4a, 4b, 4c, 4d) from the location information and the positions of at least the first and second reference point (2a', 2b'),

it being possible for individual steps or a plurality of the steps to be repeated.

2. Method according to Claim 1, characterized in that, in the automatic detection and derivation of location information, at least
   - an inclination of the measuring appliance and/or
   - an emission direction of the laser radiation

is determined indirectly or directly and an actual orientation of the measuring appliance is derived.

3. Method according to Claim 2, characterized in that the emission direction is determined by configuring a defined trajectory.

4. Method according to any of the preceding Claims, characterized in that the first and second reference points (2a', 2b') are detected on the basis of their reflectivity of the laser radiation (L), in particular by using cooperative targets for establishing the reference points (2a, 2a', 2b, 2b').

5. Method according to any of the preceding Claims, characterized in that, in the automatic detection, the reference points (2a', 2b') are distinguished from one another, in particular by recognition of individual codes or individual physical properties coordinated with each reference point (2a, 2a', 2b, 2b'), preferably on the basis of spectral selectivity.

6. Method according to any of the preceding Claims, characterized in that, in the automatic detection and derivation of location information recording of images is effected.

7. Method according to Claim 6, characterized in that the first and/or second reference points (2a', 2b') are detected using image processing methods.

8. Method according to Claim 6 or 7, characterized in that the location information for at least the detected first and second reference points (2a', 2b') are derived using image processing methods.

9. Method according to any of the preceding Claims, characterized in that the scanning movement (6, 6', 6'') is effected by scanning, in particular in a rosette-like or zig zag manner.

10. Method according to any of the preceding Claims, characterized in that, in the automatic detection, automatic target tracking of at least one of the reference points (2a, 2a', 2b, 2b') is effected.

11. Method according to any of the preceding Claims, characterized in that the location information and/or the alignment information for at least the detected first and second reference points (2a', 2b') are simultaneously derived.

12. Method according to any of the preceding Claims, characterized in that an additional derivation of the actual position (AP, AP1, AP2, AP3) and/or of the actual orientation is effected by means of inertial sensors (21) in particular for the interpolation of the actual position (AP, AP1, AP2, AP3) and/or of the actual orientation.

13. Method according to any of the preceding Claims, characterized in that the measurement of the distance is effected according to one of the following principles

- phase measurement,
- pulse transit time measurement,
- pulse transit time measurement with threshold value determination,
- pulse transit time measurement with HF sampling.

14. Use of a method according to any of the preceding Claims for correcting deviations, in particular drift effects, of a positioning and/or orientation measuring device based on inertial sensors (21).

15. Measuring appliance (4a, 4b, 4c, 4d) for a method according to any of Claims 1 to 13, comprising

 - at least one radiation source (12) for producing laser radiation (L),
 - at least one measuring component for automatic detection of reference points (2a, 2a', 2b, 2b') which have been made detectable and for derivation of location information of the reference points (2a, 2a', 2b, 2b'), comprising a receiver for the laser radiation (L), the receiver being formed for distance measurement and the measuring component optionally also being suitable for deriving the positions of the reference points (2a, 2a', 2b, 2b'),

 characterized by

 - at least one control component (14) for changing the emission direction of the laser radiation (L), the control component (14) being designed so that at least one spatial

segment (5, 5′, 5′′) can be automatically scanned by laser radiation (L), and

- a position component for deriving the actual position (AP, AP1, AP2, AP3) of the measuring appliance (4a, 4b, 4c, 4d) from the location information of the reference points (2a, 2a′, 2b, 2b′).

16. Hand-held measuring appliance (4a, 4b, 4c, 4d) according to Claim 15, characterized in that the measuring component is formed for measuring angles (α, β, γ), in particular
    - between two reference points (2a, 2a′, 2b, 2b′)
    - between a reference point (2a, 2a′, 2b, 2b′) and the horizontal and/or
    - between the measuring appliance and the horizontal.

17. Measuring appliance (4a, 4b, 4c, 4d) according to Claim 15 or 16, characterized in that the measuring component is formed for determining the emission direction of the laser radiation relative to an axis of the measuring appliance.

18. Measuring appliance (4a, 4b, 4c, 4d) according to Claim 15, 16, or 17, characterized by inertial sensors (21).

19. Measuring appliance (4a, 4b, 4c, 4d) according to any of Claims 15 to 18, characterized in that the control component (14) is in the form of a

scanner, in particular in the form of a scanner having rotatable prisms or mirrors.

20. Measuring appliance (4a, 4b, 4c, 4d) according to any of Claims 15 to 19, characterized in that the measuring component has an image-recording component (17), in particular a CCD or CMOS camera, preferably in the form of a wide-angled camera.

21. Measuring appliance (4a, 4b, 4c, 4d) according to any of Claims 15 to 20, characterized in that the measuring component has a scanning detection component, in particular comprising a coaxial optical system in the form of an endoscope (16).

22. Measuring appliance (4a, 4b, 4c, 4d) according to any of Claims 15 to 21, characterized by a further telemeter (18).

23. Measuring appliance (4a, 4b, 4c, 4d) according to Claims 15 to 22, characterized in that the control component (14) is formed in such a way that the spatial segment (5, 5', 5'') is variable in its extent.

24. Measuring appliance (4c) according to Claims 15 to 23, characterized in that the control component (14) is formed in such a way, that at least two spatial segments (5'') can be scanned independently of one another, in particular by two trackers for target tracking.

25. Measuring appliance (4a, 4b, 4c, 4d) according to any of Claims 15 to 24, characterized by a display for confirming that the measuring appliance (4a, 4b, 4c, 4d) has assumed a predetermined position.

26. Measuring appliance (4a, 4b, 4c, 4d) according to Claim 25, characterized by a computing component for deriving predetermined positions, in particular by establishing a start position (SP) and an end position (EP) between which processing positions (BP) can be automatically derived by the computing component according to a specified scheme.

27. Local position-determining system comprising a measuring device (4a, 4b, 4c, 4d) according to Claims 15 to 26 and at least two reflectors for establishing reference points (2a, 2a', 2b, 2b') which have been made detectable.

28. Local position-determining system according to Claim 27, characterized in that at least one of the reflectors is in the form of one of the following elements, in particular in the form of an element provided with a coding or a spectral selectability:
- glass spheres, in particular as full spheres or hemispheres,
- retroreflective foil,
- triple prism.

29. Use of the method according to any of Claims 1 to 13 for marking processing positions, where

- a first actual position as start position and a second actual position as end position are defined by the method and
- processing positions are automatically derived according to a specified scheme between start position and end position, so that the assumption of a processing position can be verified by the method.